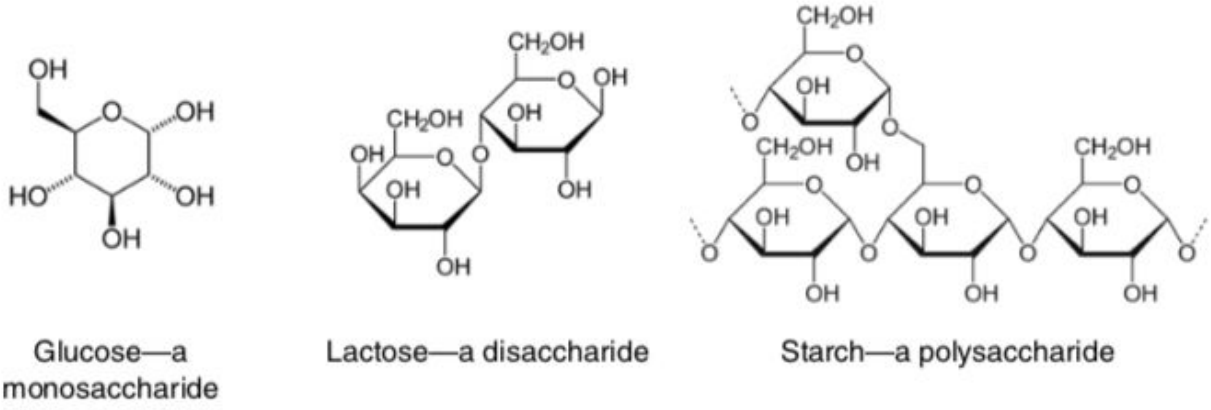
Lab 5: Cellular Respiration: How Does the Type of Food Affect the Rate of Cellular Respiration in Yeast?

Introduction

One characteristic of living things is they must take in nutrients and give off waste in order to survive. This is because all living tissues (which are composed of cells) are constantly using energy. In plants, animals, and fungi this energy comes from a reaction called cellular respiration. Cellular respiration refers to a process that occurs inside cells. During this process oxygen is used to convert the chemical energy found within a molecule of sugar into a form that is usable by the organism. The following equation describes this process:

sugar (CHO) + oxygen (O_2) → water (H_2O) + carbon dioxide (CO_2) + energy (ATP)

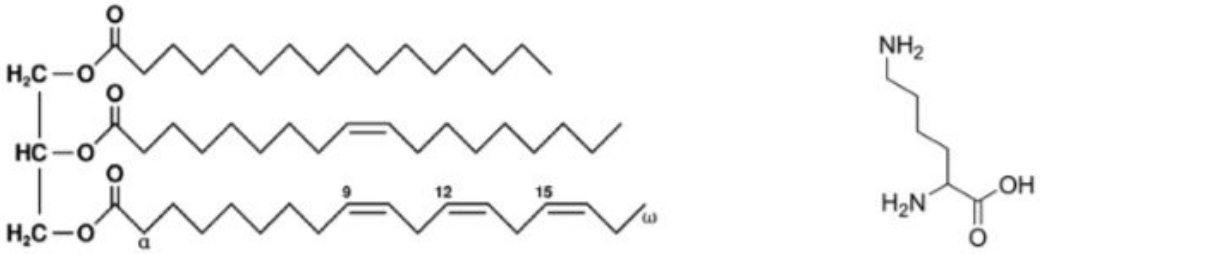
Sugar is a generic term used to describe molecules that contain the elements carbon, hydrogen, and oxygen. Biologists also call sugars carbohydrates or saccharides. There are many different types of sugar (see the figure below). Simple sugars are called monosaccharides; examples include glucose and fructose ($C_6H_{12}O_6$). Complex sugars include disaccharides and polysaccharides. Examples of disaccharides include lactose, maltose, and sucrose ($C_{12}H_{22}O_{11}$). Examples of polysaccharides include starch, glycogen, and cellulose.



Glucose—a monosaccharide | Lactose—a disaccharide | Starch—a polysaccharide

In addition to carbohydrates there are other type of molecules found in plants and animals that could serve as potential energy sources because they also contain the elements carbon, hydrogen, and oxygen. These molecules include lipids and proteins, as shown in the figure below. Lipids do not share a common molecular structure like carbohydrates. The most commonly occurring class of lipids, however, is triglycerides (fats and oils), which have a glycerol backbone bonded to three fatty acids. Proteins contain other atoms such as nitrogen and sulfur, in addition to carbon, hydrogen, and oxygen.

Examples of (a) a lipid and (b) an amino acid found in proteins



(a) Triglyceride—a lipid | (b) Lysine—an amino acid found in proteins

Yeast, like most types of fungi, produce the energy they need to survive through cellular respiration. In this investigation, you will determine if yeast can use a wide range of nutrients (e.g., proteins, fats, and different types of carbohydrates) to fuel the process of cellular respiration.

Your Task

Design a controlled experiment to determine how the type of food source available affects the rate of cellular respiration in yeast. To do this, you will need to determine if yeast produces CO_2 at different rates in response to a change in a food source.

The guiding question of this investigation is: **How does the type of food affect the rate of cellular respiration in yeast?**

Materials

You may use any of the following materials during your investigation:

- Yeast suspension
- Food source 1: starch (polysaccharide)
- Food source 2: sucrose (disaccharide)
- Food source 3: lactose (disaccharide)
- Food source 4: glucose (monosaccharide)
- Food source 5: protein
- Food source 6: lipid
- Beakers
- Clear plastic or glass cups
- Marker
- Ruler

Getting Started

To answer the guiding question, you will need to design and conduct a series of controlled experiments. To accomplish this task, you must determine what type of data you will need to collect, how you will collect it, and how you will analyze it.

To determine *what type of data you need to collect*, think about the following questions:

- What type of measurements or observations will you need to record during your investigation to determine the respiration rate of yeast?

To determine *how you will collect your data*, think about the following questions:

- What will serve as the dependent (manipulated) variable during the experiment?
- What will serve as the independent (responding) variable?
- What other factors will you need to keep constant (controlled variables)?
- What will serve as a control condition?
- How will you make sure that your data are of high quality (i.e., how will you reduce measurement error)?
- How will you keep track of the data you collect and how will you organize the data?

To determine *how you will analyze your data*, think about the following questions:

- What type of calculations will you need to make?
- What type of graph could you create to help make sense of your data?

Report

Once you have completed your research, you will need to prepare an investigation report that consists of four sections (be sure to have section headings):

1. Introduction: Give some background information on the topic. Explain what question were you trying to answer and include a hypothesis. (Background info, research question and hypothesis)
2. Procedure: What did you do during your investigation and why did you conduct your investigation in this way? (How you collected and analyzed data)
3. Data: Include a data table and/or graph to show your results. Be sure to include a title for your table or graph with labels for the variables.
4. Conclusion: What is your argument? (Claim - Evidence - Reasoning)